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The Journal of HEREDITY

FINGERPRINTS OF IDENTICAL TRIPLETS

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Statistics of Child Behavior

VOLUME 23 JUNE, 1932 NUMBER 6

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The proportion of blindness determined by heredity, and a list of the forms of blindness known to run in families.

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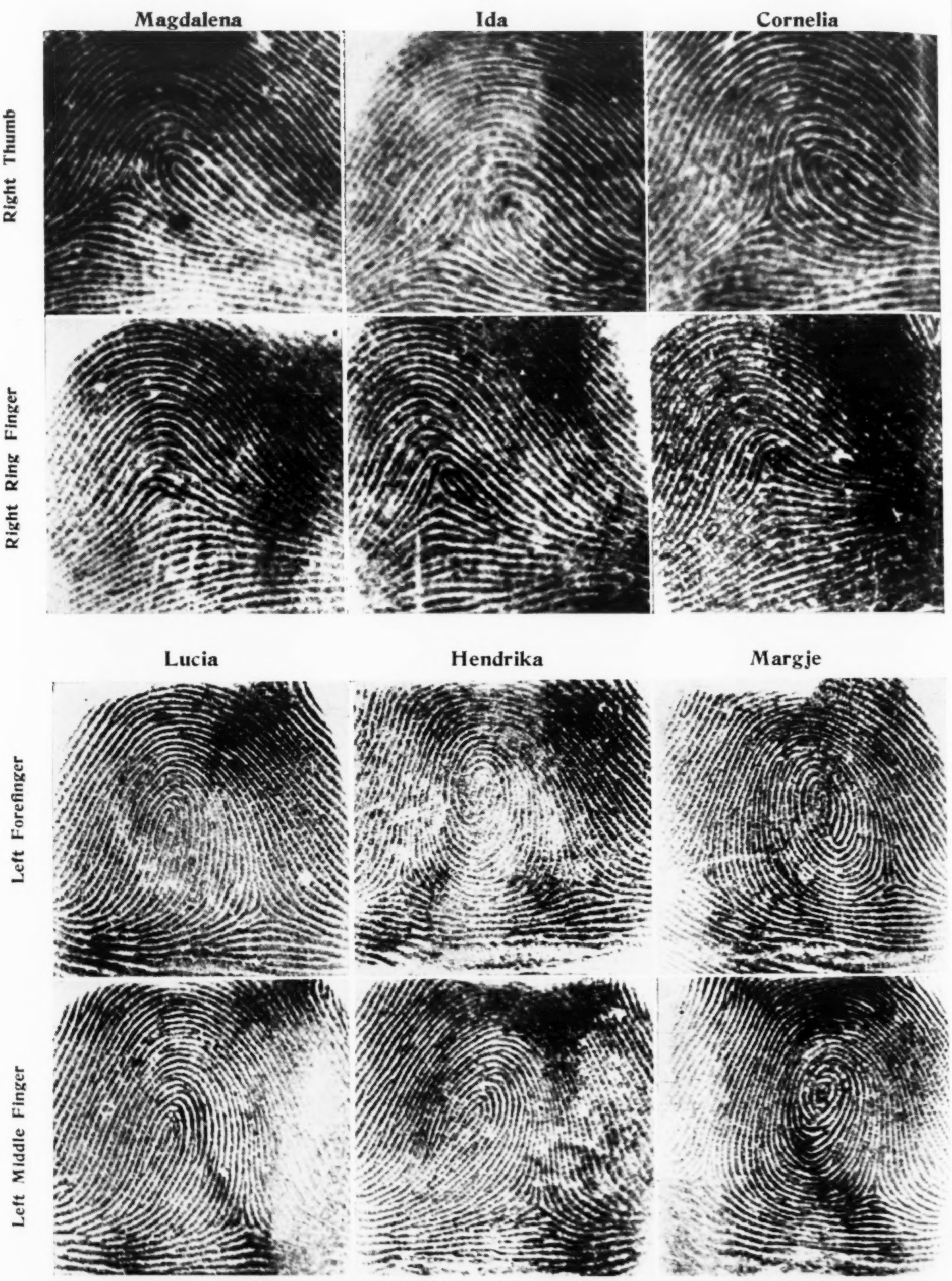


ENLARGED FINGERPRINTS OF TWO SETS OF TRIPLETS

Frontispiece

Fingerprints of two fingers of two sets of triplets, to show differences in degree of resemblance. The fingerprints of Magdalena, Ida, and Cornelia resemble each other much more closely than do those of Lucia, Hendrika, and Margje. Nevertheless the latter show sufficently striking cross-resemblance to contribute rather convincing evidence that the triplets are derived from a single fertilized egg cell. The prints of the left middle fingers of Lucia and Hendrika are extremely similar but they are little more so than the prints of the left forefingers of Hendrika and Margje. Similarities such as these would rarely if ever be found in the fingerprints of fraternal twins or of ordinary brothers and sisters. The triplets are as alike as the fingerprints. (See Figures 1 and 2.)

SIMILARITIES IN TRIPLETS

A Contribution to the Knowledge of Heredity In Triplets

J. SANDERS, M. D.
Rotterdam, Holland

SINCE the English anthropologist Francis Galton published in 1876 his famous essay on twins, many writers have given their attention to this subject and have emphasized the importance of these investigations for research concerning the laws of heredity. Nearly fifty years afterwards Wilder, Newman, Siemens and others gave a new impetus to the investigation of twins by introducing a systematic diagnoses of similarity. Siemens found that the diagnosis of one-egg twins (identical) or two-egg twins (fraternal) is not always to be derived from placenta and chorion. Subsequent investigations by Siemens himself as well as by many others (Von Verschuer, Curtius, Waardenburg, Bar) confirm this opinion.

Various difficulties adhere to the diagnosis by means of placenta and fetal membranes and according to Siemens the principal objections are:

1. Generally one has to fall back on the memory and for the greatest part on that of the mother. Also the statements of midwives and physicians are not wholly to be trusted. Most reliable are written annotations made by them and in that case it is necessary to specify the reasons on which the diagnosis is founded. 2. To base a diagnosis on one placenta and one chorion is often extraordinarily difficult. A large part of the twins of the same sex born in clinics remain without diagnosis as regards the fetal membranes. Prinzing found that of 1,088 twins, born in seven university clinics, 17 per cent were put down as uncertain (identical *or* fraternal). For the twins of similar sex the percentage is 30. Among 848 cases in the literature Prinzing found 206 uncertain.

Therefore Siemens looked for another method and he finally adopted the polysymptomatic system. He did not base his diagnosis on placenta and fetal membranes, but on a systematic investigation of the whole body. He worked out the following scheme, consisting of twelve points, which are on the whole sufficient to ascertain if we have to do with identical twins or with fraternal:

1. Hair color and form.
2. Eye color.
3. Skin color.
4. Downy hair of the body.
5. Freckles. (Location of.)
6. Appearance of blood in the skin.
7. Follicular processes. (Lichen pilaris, acne.)
8. Tongue (furrowed or not) and teeth.
9. Form of face and head. (Physiognomy.)
10. Form of ear.
11. Form of hands (and of nails).
12. Body build.

In cases that still remain doubtful or to make the investigation as complete as possible, the following three additions are to be considered:

13. Mental make up. (School standing, character, talent.)
14. Illness and abnormalities.
15. Traits which are the bases of special methods of investigation. (Fingerprints, microscopic comparison of the capillaries, refraction of the eyes, blood groups and so on.)

According to Siemens the traits 1, 2, 3, and 4 agree always in identical twins, almost never in fraternal twins. The traits 5, 6, 7, and 8 differ among identical twins only within narrow bounds and only as an exception; among fraternals they usually differ a little more. Traits 9, 10, 11 and 12 are as a rule more similar in identical twins than in fraternal; with the latter agreement is rarely encountered.

The dactyloscopic method was first

applied by Wilder and has been developed by Poll, Bonnevie and Leven; the palm prints by Rominger. It was evident that these prints in themselves alone were not sufficient to reach a diagnosis. Siemens sent seven sets of fingerprints from twins to Poll and Rominger. From their answer it appeared that for half of them the diagnosis was uncertain.

The matter of psychical qualities also seem to agree more in identicals than in fraternals. Muller has given an account in this journal of a case of twins reared apart. At two weeks of age the two children were separated from one another. As adults they met for the first time. Then so great was the similarity between them, bodily as well as mental, that one-egg twins could be positively determined. Newman described three similar cases two years later, and Siemens has placed on record a similar case of two German boys.

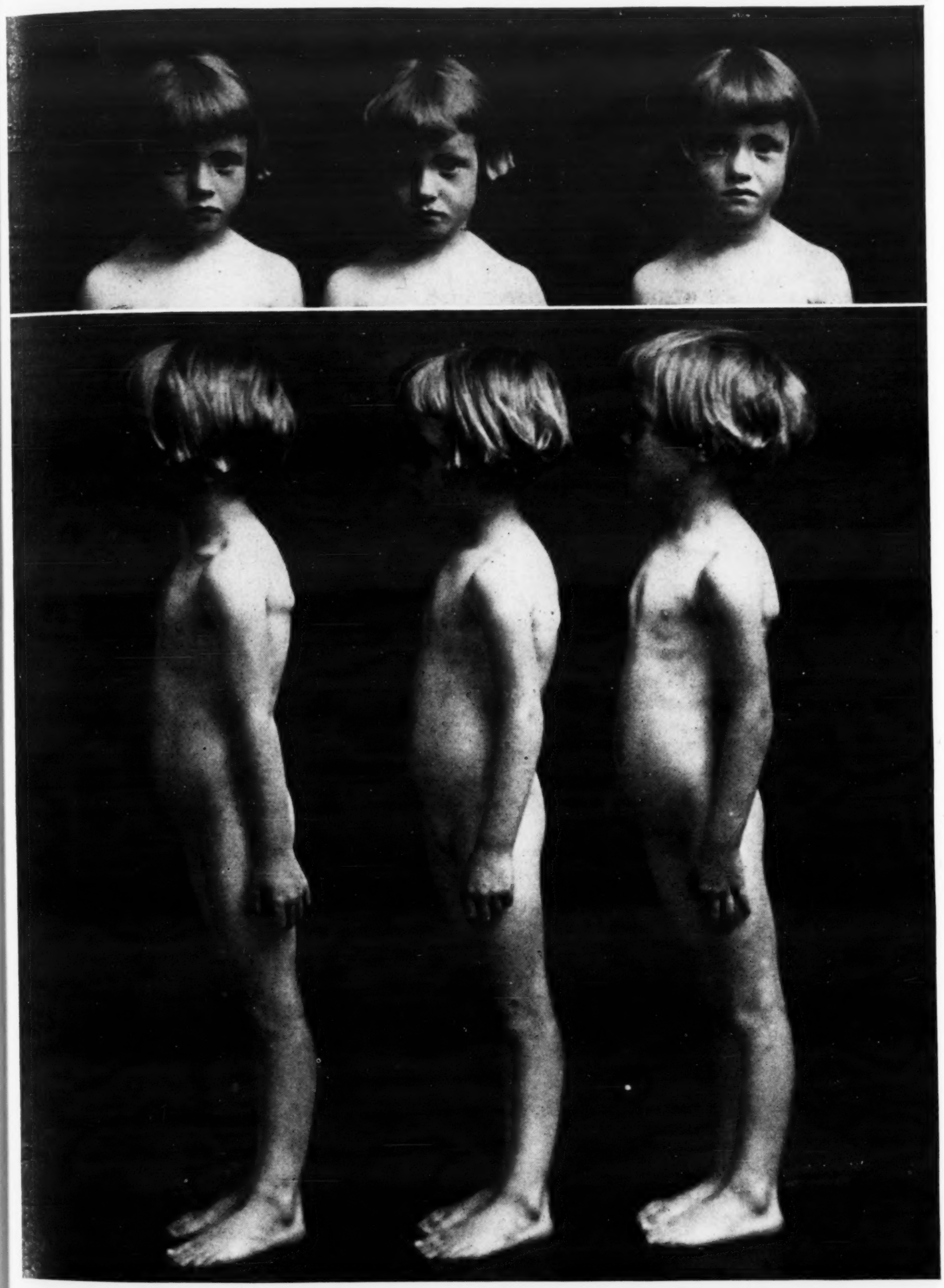
Further Siemens found, that of 29 fraternal twins of the same sex, examined by him, it was 17 times reported that their school standing differed much, 6 times it differed little and 6 times not at all. Of the 45 identical twins only 8 showed little differences, the other 37 no differences at all.

Identical Triplets

By a lucky chance I had the opportunity to examine two sets of triplets. Prof. J. P. Kleiweg de Zwaan at Amsterdam was so kind as to measure the children and to calculate the indices; Inspector J. V. Tas, head of the dactyloscopic department of the Police at Rotterdam took the finger- and palm-prints and made the photographs, while my colleague Penon at Rotterdam coöperated in the mental measurements. I ask those three gentlemen to accept my thanks for their coöperation.

TABLE I.—Physical Measurements of the W— Triplets at 4½ Years of Age.

	Magdalena	*Ida*	*Cornelia*		*Magdalena*	*Ida*	*Cornelia*
Length of head	15.7	15.7	15.6	Knee joint—bottom	25.8	24.7	23.5
Breadth of head	13.4	13.3	13.1	Malleolus internus—bottom	5.1	4.0	3.9
Smallest frontal breadth	8.9	9.4	9.0	Edge of breastbone—bottom	76.3	75.0	74.2
Breadth of zygomatic arch	10.3	10.4	10.5	Edge of shamebone—bottom	46.6	45.6	45.3
Breadth of lower jaw	8.0	7.7	7.7	Acromial breadth	23.3	22.4	22.2
Morphological height of face	10.0	9.8	9.7	Spinal breadth	14.9	15.5	15.6
Physiognomic height of face	13.9	13.8	13.9	Eye color	9.	9.	9.
Root of nose—mouth	6.1	6.1	6.2	Hair color	D	D	D
Length of nose	4.3	4.3	4.5	Form of the skull	L-R	L-R	L-R
Breadth of nose	2.7	2.4	2.4	Cephalic index	85.3	84.7	83.9
Depth of nose	1.2	1.3	1.2	Fronto-zygomatic index	86.4	90.4	85.7
Breadth of mouth	3.0	3.2	3.3	Jugo-mandibularis index	77.7	74.0	73.3
Distance inner corner of the eye	3.0	3.0	2.9	Morphologic face index	97.1	94.2	92.4
Distance outer corner of the eye	7.4	7.3	7.1	Physiognomic face index	74.1	75.3	75.5
Length of ear	4.7	4.7	4.3	Nasal index	62.8	55.8	53.3
Breadth of ear	2.9	2.9	2.8	Physiognomic ear index	61.7	61.7	65.1
Horizontal circumference of the head	48.	46.8	46.3	Total arm length	41.4	38.9	42.0
Bodily length	98.	97.2	96.7	Relative arm length	42.3	40.0	43.4
Acromion—bottom	74.	72.9	74.	Upper arm length	17.8	15.7	17.8
Capitulum radii—bottom	56.2	57.2	56.2	Lower arm length	14.1	12.9	13.1
Tip middle finger—bottom	32.6	34.0	32.0	Hand length	9.5	10.3	9.1
Processus styloideus radii—bottom	42.1	44.3	43.1	Brachial index	79.2	82.1	73.9
Spina anterior superior—bottom	53.8	51.6	50.5	Relative length of leg	54.9	53.1	52.2
				Upper leg length	28.0	26.9	27.0
				Lower leg length	20.7	20.7	19.6
				Tibio femoral index	73.9	76.5	72.6
				Trunk length	29.7	29.4	28.9



MAGDALENA, CORNELIA, IDA—IDENTICAL TRIPLETS

Figure 1

Showing similarities in stature and in physiognomy. These are the girls with the more nearly identical fingerprints. It is recorded that the birth membranes of these triplets were of the type that would indicate that they were not identical. This case furnishes further evidence of the unreliability of this method of classifying twins and triplets as identical or fraternal.

Now follows a description of the first triplets.

Magdalena, Ida and Cornelia W—— were born March 17, 1926 (Figure 1). The midwife, who assisted at the delivery, took down at the time and is yet quite sure about it that one large placenta and two chorions were present. Magdalena weighed at her birth 1,600 grams, Ida nearly 1,500 grams and Cornelia 1,100 grams. In the same order of succession the children were born. At first they were reared in an incubator and for seven months they received natural nutrition.

The measures and the indices of the children, recorded in August, 1930, are given in Table I. The eye color is determined with the eye color index of Rud. Martin; the hair color with hair color index of Fischer-Saller.

In the photographs of the children it is distinctly to be seen that all three have a dent in the right part of the chest under the mammilla. Furthermore all three girls have the second toe on the right foot smaller than the first and third, and, on the left foot, smaller than the first but larger than the third. Added to this Ida has, about 6 cm. left of the nombril, a birth-mark large as a pin's head and also one on the left ringfinger.

As to the mental condition of the children it is evident that all three children have their attention easily distracted. When asked for instance: "What is a horse?" immediately a tale follows. "This morning, walking with my mother, I saw a horse that would not go," or something like that. When, however, the attention has been fixed by asking several times the same thing, then the answer comes in most cases fluently. According to the Binet Scale the intelligence coefficient (IQ) is for Magdalena 95, for Ida 93, and for Cornelia 90. The mother asserts that the characters of the three children are nearly the same. However Magdalena and Cornelia play more with each other and Ida more by her self.

With regard to the fingerprints Mr. Tas acquainted me with the following facts:

As I have to assume ignorance of the principles of dactyloscopy by the reader, I will discuss briefly the nature of the fingerprint.

It is known that the inner part of the fingertips is traversed in all directions by lines of varying lengths, the so called papillary lines. Except scars and enlargement by growth these figures remain the same. The pattern of these forms from the moment of their coming into existence during the embryonic state until they are destroyed by death, never varies. Furthermore, every person has a pattern that does not exist for a second time on the earth.

These two facts give the fingerprints their criminological value. All dactyloscopists have met in their practice with the fact that the finest details remain always the same.

Are there at one's disposal two fingerprints, taken some time after another, of the same criminal and is the last description almost quite illegible as a result of a thorough damage of the fingertips (this often happens with persons whose hands are always in contact with rough implements of their trade, for instance, bricklayers and firemen), then it appears after a "dolce far niente" in prison that the dactyloscopic pattern returns after a short time and is quite the same as at first. Details on a scale of fractions of a millimetre appear in their original form.

Also from a criminological point of view it is of importance to find out how far twins, triplets and, more especially, those of the one-egg variety, fail to adhere to these rules by having the same or similar fingerprints.

We distinguish in the pattern of the fingertips six principal forms:

1. *The Arch.* In this type the ridges run from one side to the other, making no backward turn.

2. *The Tented Arch.* Here the little curve of the common arch is replaced by a pronounced upward thrust near the middle. The ridges thus converging give to the pattern the appearance of a tent in outline.

3. *The Loop.* In loops some of the ridges coming from one side make a backward twist of 180° and return round a core.

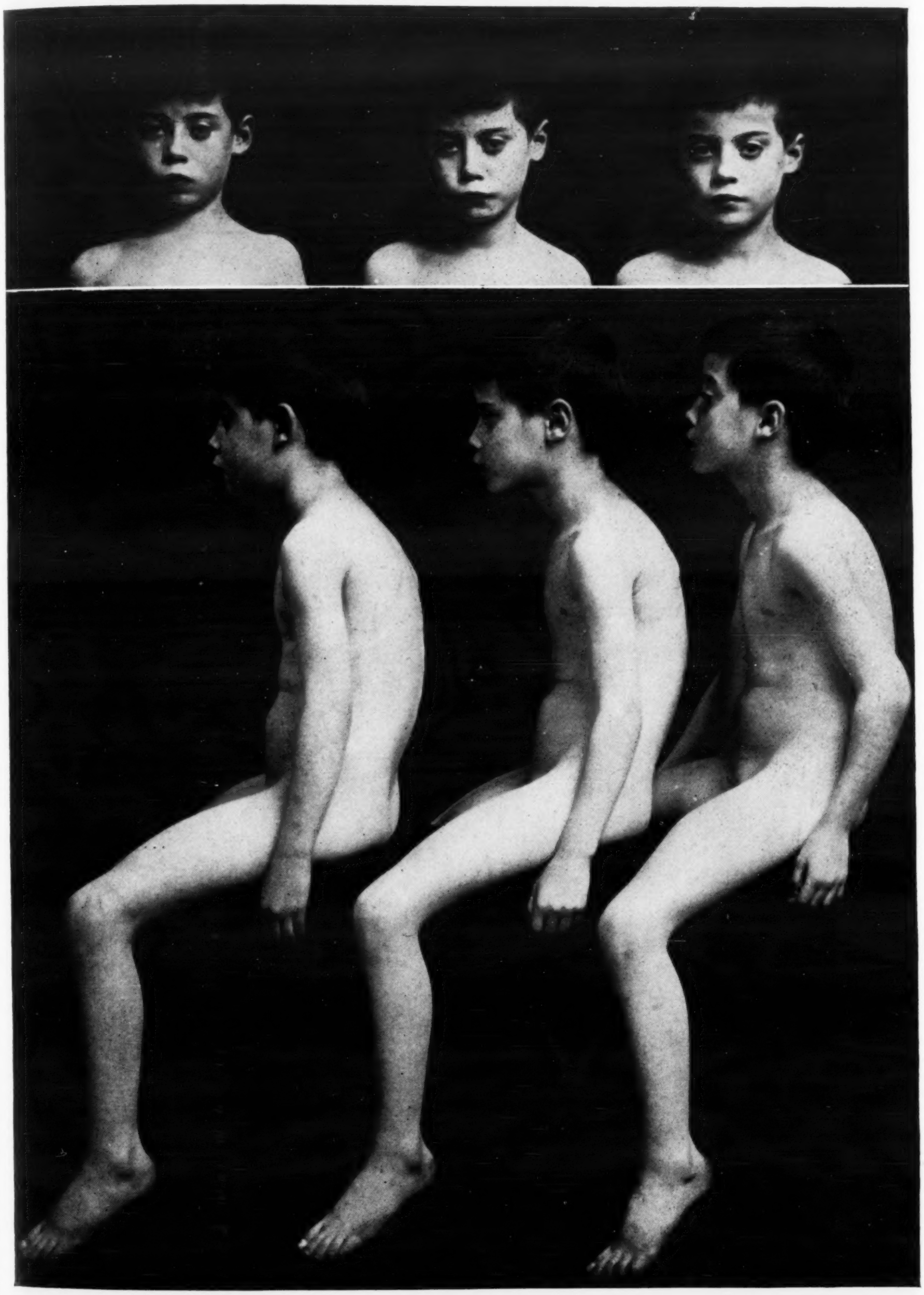
4. *The Twinned Loop.* This has the ridges bending double after forming the loop, the result is something like a butcher's hook.

5. *The Whorl.* With this type the ridges turn in circles or ellipses round a core.

6. *The Composites.* Under composites are included patterns in which combinations of the other five forms are found.

Loops are supported on one side by one delta, formed by an abrupt divergence of two ridges. Whorls and twinned loops are on the left and right under-side supported by a delta and so have two deltas.

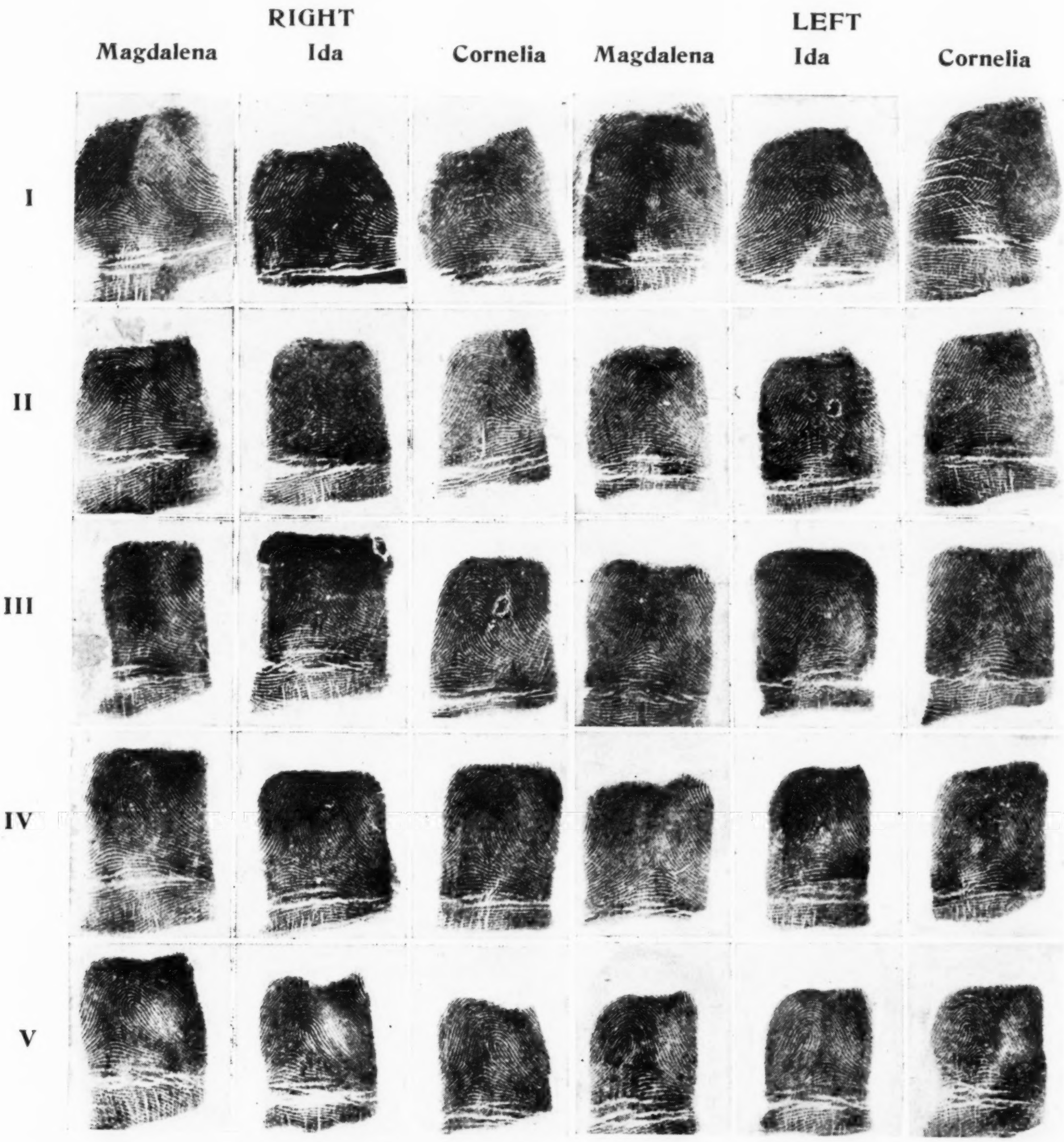
The number of capillary ridges between core and delta is also important, while atten-



HENDRIKA, LUCIA, AND MARGJE

Figure 2

The difference in these triplets is so slight that appearance alone would almost establish them as identical triplets. Quite remarkable cross-similarities in small details and peculiarities were discovered. Note especially the shape of the back of the head.



REMARKABLE SIMILARITIES OF FINGERPRINTS

Figure 3

While many of the minor details of the fingerprints are different, such similarity in the main outlines of the patterns is never found in non-identical twins or in ordinary brothers and sisters. The fingerprints alone establish unequivocally that these triplets are derived from a single egg cell. The absence of mirror imaging in the fingerprints shows that the early embryonic cell mass must have separated into three growth areas before differentiation had begun.

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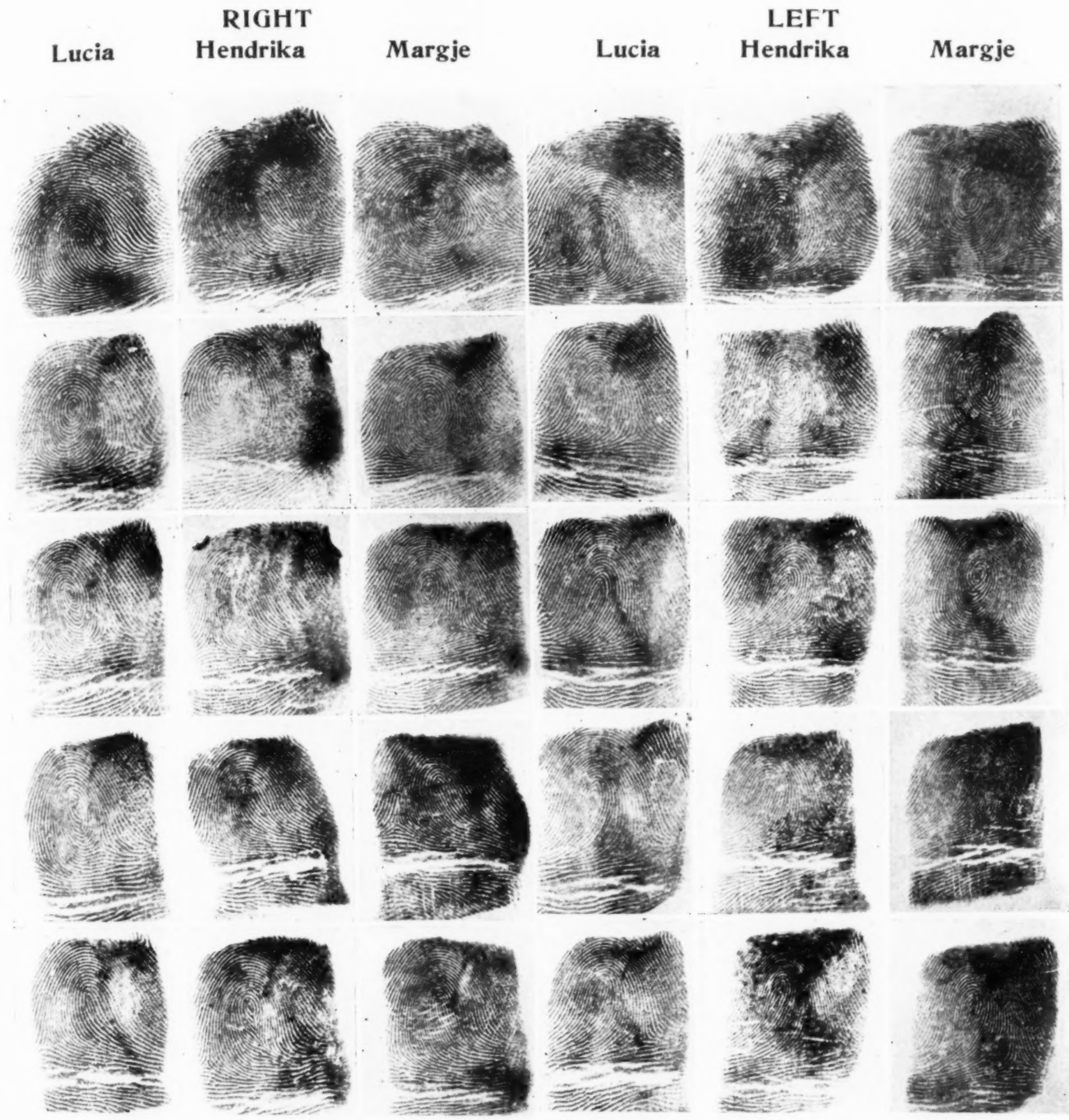
tion is drawn to all kinds of transition forms existing between the principal forms, by which some loops somewhat approach an arched pattern or show a whorl.

When we look at the fingerprints of the *IV* triplets, we see at once a striking similarity (Figure 3). As a stranger can suddenly give utterance to his astonishment at a striking likeness by exclaiming: "How that child resembles his father!" so for a dactyloscopist there is no escape from the feeling that a great congeniality exists, in spite of many differences in smaller details.

Firstly all children show in the identical fingers loops of about the same quality, that is to say, loops of more or less the same



GREATER VARIATION IN FINGERPRINTS

Figure 4

The fingerprints of this set of triplets show less cross-resemblance than those of the other set. Nevertheless the similarities are rather more remarkable than the differences. The prints of Lucia and Hendrika resemble each other more than they do those of Margje; but in some instances the three prints are very much alike, as in the case of the left ring fingers. It is probably safe to say that no examples of similarities approaching these have been recorded among non-identical twins or ordinary brothers and sisters.

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form with about the same number of ridges between core and delta (Frontispiece).

Secondly, all other principal forms are found wanting in the three children, except the arch in both fore-fingers of Magdalena.

Thirdly, the two fore-fingers of Magdalena show really a certain relationship with the two other children. What is here actually the case? Ida shows in both her fore-fingers the loop, leaning, however, already towards the arch. Cornelia also has the loop in the two fore-fingers. Here, however, the leaning towards the arch is yet stronger. Finally, we see in Magdalena's patterns, both her fore-fingers the pronounced arch. Nature shows here a gradual transition from loop to arch, going from Ida via Cornelia to Magdalena.

It would carry me too far to go too deep into the composition of the dactyloscopic formula. Making out the formulae, for instance, according to the system of Henry, all three children are found to belong to the same head

class, namely that of the class $\frac{1}{1}$. Henry divides all dactyloscopic descriptions into 1024 classes, going from class $\frac{1}{1}$ to class $\frac{32}{32}$.

According to Henry the complete formulae for these children are:

Magdalena	$\frac{1}{1}$	$\frac{A}{A}$	$\frac{(i)i}{(i)i}$
Ida	$\frac{1}{1}$	$\frac{U}{U}$	$\frac{i\ i}{i\ i}$
Cornelia	$\frac{1}{1}$	$\frac{U}{U}$	$\frac{i\ i}{i\ i}$

The layman, too, will see the striking similarity of the formulae.

The almost absolute similarity of the bodily characteristics as well as that of the mental qualities shows that we have here a case of one-egg triplets, in spite of the definite statement of the midwife. In the introduction it has already been noted that Siemens, Von Verschuer, Waardenburg, and Curtius have published cases of one-egg twins, at whose birth two choria were found according to the physician.

The second triplet E. was born on December 9, 1922 in the Training College for midwives at Rotterdam (Figure 2). Borrowed from the history of the parturition are the following facts:

Lucia is born at 4.30, Hendrika at 5.10 and Margje at 5.50. The measures of the children at birth and in August, 1930, are given in Table II.

TABLE II. Physical Measurements of the E— Triplets

	Lucia	*Hendrika*	*Margje*
Length	45.	42.5	47.5
Weight at birth	2000.	1830.	2390.
Sizes of the skull:			
Medium circumference	30.	30.5	33.5
Greatest circumference	33.	33.	35.5
Smallest circumference	28.	25.	.29
Great transverse	8.4	7.8	8.4
Little transverse	7.1	6.7	7.6
Straight transverse	10.8	10.5	10.6
Great oblique	11.7	11.6	12.4
Little oblique	8.1	8.3	8.6
Weight when they left on March 24th, 1923	4070.	3530.	4880.
August, 1930:			
Length of head	16.1	16.5	16.5
Breadth of head	13.2	14.0	14.1
Smallest frontal breadth	9.2	9.2	9.2
Breadth of zygomatic arch	11.4	11.9	11.9
Breadth of lower jaw	8.7	9.0	8.8
Morphological height of face	10.1	10.8	10.5
Physiognomic height of face	14.5	14.8	14.5
Root of nose—mouth	7.1	7.3	6.6
Length of nose	4.9	5.0	4.7
Breadth of nose	2.8	2.7	2.8
Depth of nose	1.4	1.4	1.5
Breadth of mouth	4.1	4.2	4.0
Distance inner corner of the eye	2.5	2.6	2.7
Distance outer corner of the eye	7.4	7.3	7.4
Length of ear	5.2	5.1	4.8
Breadth of ear	3.2	3.0	3.1
Horizontal circumference of the head	47.0	48.5	48.6
Bodily length	119.7	120.7	117.4
Acromion—bottom	94.1	95.7	93.1
Capitulum radii—bottom	74.2	73.6	72.9
Tip middle finger—bottom	44.3	44.8	42.9
Processus styloidei radii—bottom	57.7	57.6	58.9
Spina anterior superior—bottom	65.7	65.7	64.1
Knee joint—bottom	30.8	31.7	30.3
Malleolus internus—bottom	5.3	4.6	5.0
Edge of breastbone—bottom	94.6	95.1	92.6
Edge of shame bone—bottom	58.3	57.9	58.6
Acromial breadth	25.9	26.4	25.5
Spinal breadth	17.5	17.3	17.0
Eye color	12.	12.	12.
Hair color	P	P	P
Form of the skull	*	**	***
Cephalic index	81.9	84.8	85.4
Fronto-zygomatic index	80.7	77.3	77.3
Jugo-mandibularis index	76.3	75.6	73.9
Morphologic face index	88.6	90.8	88.2
Physiognomic face index	78.6	73.8	82.1
Nasal index	57.2	54.0	59.1
Physiognomic ear index	61.5	58.8	64.6
Total arm length	49.8	50.9	50.2
Relative arm length	41.6	42.2	42.7
Upper arm length	19.9	22.1	20.2
Lower arm length	16.5	16.0	17.0
Hand length	13.4	12.8	13.0
Brachial index	82.9	72.4	84.6
Relative length of leg	54.9	54.5	54.6
Upper leg length	34.9	34.0	33.8
Lower leg length	25.5	27.1	25.3
Tibio femoral index	73.1	79.9	74.9
Trunk length	36.3	37.2	34.0

* Form of a point 3 centimeters left of the median line.

** The same to the right.

*** The same to the right.

The placenta was large, 25 by 30 cm., and weighed 1,400 grams. It resembled a surface consisting of three placentae, which formed together one whole. The navel-strings of the first and second child were membranously implanted. The third navel-string was implanted exactly near a deep cleft between placenta I and II. There were three amnia and one continuous chorion. Consequently we have here a case of one-egg triplet.

Lucia has a little pigment spot on the chest, a little above the right arm-pit and one near the left arm-pit. They are as large as a pin's head. Hendrika has the same spot at the right, 2 cm. under the collar-bone, 6½ cm. above the papilla mammae. All the three children have on both sides the second toe smaller than the first and larger than the third. At the same place every one of them has on the center of the skull a protuberance and the skull is flattened at the back. In Figure 2 this is distinctly to be seen.

As regards the psychic condition, all three children must be rated as stupid. The Benet intelligence coefficient is for Lucia 88, for Hendrika 88, for Margje 80. The scholastic knowledge of Lucia and Margje is that of a child at the end of the first form. Lucia is a little more vivid and less slow than Hendrika. According to the mother she cannot very well run messages as she often forgets what she was sent for.

Hendrika is a bit slow, but with patience she improves. She has a tendency to remain in the rectal form. During the examination she uses the minimum number of words. At home she talks much according to her mother. She is able to run messages to the grocer. She does not lead at games.

Margje is a little more shallow; she reflects less. She cannot carry messages.

All three children are addicted to biting their nails.

The teacher tells us that Lucia and Margje are having to repeat the second form; Hendrika was just able to pass. He does not consider them mentally deficient, but thinks them very stupid. All three are rather impertinent.

As to the fingerprints declares Mr. Tas:

> Though Prof. De Snoo could establish the fact that we have here a case of one-egg triplet, the fingerprints show rather big differences, even in the principal forms (Figure 4). The most striking differences have been reproduced in the enlarged photographs (Frontispiece).

The right ring-finger (Figure 4) shows in Margje an ulnar loop and also in Hendrika, where the loop has, however, a tendency to an ulnar whorl. Lucia has in this finger an ulnar whorl.

The left middle-fingers (Frontispiece) show in the same order of succession (Margje, Hendrika, Lucia) an ulnar whorl, an ulnar loop with slight tendency to whorl and an ulnar loop.

The left fore-fingers (Frontispiece) show, respectively, a radial whorl, an ulnar whorl and an ulnar loop. More or less we could see here a gradual transition in the principal forms from Margje over Hendrika to Lucia, which does not alter the fact that the dactyloscopic formulae of these triplets are quite different. According to Henry's system they should read:

Margje	23 ii / 27 oo
Hendrika	17 i / 3 m
Lucia	25 io / 9 oo

For this second case of triplets we have to conclude that a great bodily and mental similarity exists. On the strength of these data it is beyond doubt that we have here one-egg triplets, as was stated by the physician. Yet the similarity of these triplets is not as striking as that of the first case, where the midwife stated expressly that two choria were found.

Mr. Tas resumes, after having concluded his dactyloscopic investigations and also in connection with other experiences obtained with other cases of children born at the same time:

1. With monozygotic twins, triplets, etc.,

the fingerprints of the same fingers *can* be strikingly similar, so that the non-initiated qualify them absolutely as similar.

2. The more subtile design of details of the ridges is with one-egg triplets, also, always quite different.

3. With one-egg twins, triplets, etc., the fingerprints of the same fingers *can* even deviate strongly in the principal forms, though often a gradual transition of them can be ascertained with triplets.

The lines of the palm follow the same rules.

Practice teaches us that no fixed rule can be laid down. Nature has its whims in this respect and sometimes shows a pronounced similarity, while in other cases it is absent, or, at most, a connection can be found where a gradual transition of the principal forms is existing.

For the sake of completeness, I have to mention the fact that between very near relations (for instance, father and son, brother and sister) sometimes the family tie is plainly visible, though generally not so striking as with monozygotic twins, triplets and so on.

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Introduction of Africander Cattle

A shipment of 29 cattle of the Africander breed from three Provinces in South Africa arrived in New York City late in December. This is the first importation of such cattle to the United States, according to W. H. Black of the United States Department of Agriculture, who selected the animals and is supervising the shipment.

After remaining in quarantine for 60 days the herd will be shipped to a ranch in Texas where it will be used in breeding experiments conducted by the department and the owners of the ranch. The purpose is to develop if possible a strain or cross of cattle that will be especially adaptable to the Gulf coast regions of the United States, where a hardy animal is required.

The new cattle are a rich red color, are excellent rangers, and are gentle in disposition. The horns are rather long and have a distinctive curve, some upward and others drooping. When slaughtered, Africander cattle are said to have an unusually high percentage of dressed carcass to live weight. Until recently Africander cattle have been raised in their native country principally for draft purposes. The 29 imported cattle consist of 16 bulls and 13 females.

INHERITANCE OF WHITE SHEATH IN MAIZE

F. H. Clark*

MANY chlorophyll defects in corn have been observed and their breeding behavior established. Others have been reported and described; however, very little has been published concerning their exact mode of inheritance. The white sheath character in corn is a good example of this latter class. It was described in 1921 by Kempton[1] who reported that it was a recessive character. The purpose of the present investigation was to determine the factorial composition and, if possible, the linkage relations of a white sheath which arose from a different source than that reported by Kempton.

Source of Material

The white sheath used in this investigation was first noticed in a pollen used in an inter-row corn crossing block at the Michigan Experiment Station at East Lansing in 1923. This pollen strain consisted of three ears selected from the Duncan variety of corn. In 1924, this strain was used as the check in an ear-to-row corn test, and the white sheath plants which appeared were turned over to the writer for the purpose of making these studies.

Description of Material

White sheath in corn shows up in the early seedling stage and lasts during the entire life of the plant. A typical white sheath plant has the following characteristics: The leaf sheaths are light green to vivid white, the whiteness in the seedling stage often extending into and including the basal half of the leaves. Later in development, the leaves become normal green except in some strains where the whiteness extends into the basal portion of the leaf in the form of irregular white stripes. This striping of the leaves may appear as vividly on a plant with light green white sheath as on one having white sheath of the greatest intensity, but is usually found associated with the latter type. This whiteness of the sheath extends from the very basal portion of the stalk to the tassel node and includes the outer husk covering the ear. On a white sheath plant the anthocyanin pigment shows up as a bright red color on the base of the stalk and contrasts sharply with the whiteness above.

Crosses Between Different Grades of White Sheath

Many crosses were made between different intensities of white sheath and in all cases white sheath was obtained in the F_1, the greener sheaths always being dominant to the whiter ones. Segregation took place in the F_2, but there was so much variation that definite ratios could not be obtained. Apparently environment, as well as numerous modifying factors, plays a part in determining the expression of the white sheath character.

Factorial Composition of White Sheath

In crosses made between normal green sheath and white sheath plants, the F_1 plants were green sheath showing that white sheath is, like other chlorophyll anomalies in corn,

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a recessive character. Out of a total of 19 progenies involving 3926 plants, 239 plants had white sheaths. This is a very good fit to a 15:1 ratio, the deviation being only 6.4 ± 18.30. White sheath apparently depends for its expression upon the presence of two complimentary recessive factors which for convenience may be designated as ws_1 ws_1, ws_2 ws_2.

The backcross data obtained strengthened the above supposition, for in backcrosses involving white sheath we would expect to obtain a ratio of 3 green to 1 white sheath. The backcross and resulting genotypes expected may be represented as follows:

Backcross—

Ws_1 ws_1 Ws_2 ws_2 × ws_1 ws_1 ws_2 ws_2

Ws_1 ws_1 Ws_2 ws_2	3 green sheath
Ws_1 ws_1 ws_2 ws_2	to
ws_1 ws_1 Ws_2 ws_2	1 white sheath
ws_1 ws_1 ws_2 ws_2	

This expectation was realized, for in four backcross progenies made up of 750 plants, 559 were green sheath and 191 were white sheath, the deviation from a 3:1 ratio being 3.5 ± 8.0.

Several green sheath plants in one of the backcross progenies were self-pollinated and, as would be expected from the results shown above, approximately one-third of them gave a 15:1 ratio (Ws_1 ws_1 Ws_2 ws_2) and the remainder segregated in a 3:1 ratio (Ws_1 ws_1 ws_2 ws_2 or ws_1 ws_1 Ws_2 ws_2).

Crosses With Kempton's Strain

In 1926, seed of Kempton's white sheath was obtained and planted for comparison with the writer's white sheath and to cross with it. It was noted that Kempton's white sheath was very white in appearance while the writer's had the suggestion of a yellowish cast. Crosses were made and the F_1 resembled Kempton's. The F_2 showed segregation and in several progenies a 3:1 ratio was approached between the white and yellowish tints. Classification was so uncertain, however, that the attempt was given up. It may be that these slight differences in color between the two white sheaths are due to other color factors carried by the plants which affect the expression of white sheath.

The fact that nothing but white sheath plants were obtained in the F_1 in crosses between the two proves that both types carry the same factors, ws_1 ws_1 ws_2 ws_2, although it is quite possible that they differ in their modifying factors.

Linkage Tests

Plants having the white sheath character were crossed with various other types of corn in the hope of discovering evidence of linkage. An analysis of the data obtained in F_2 and backcross populations indicates that white sheath is not closely linked with sun-red, white cap, shrunken, R aleurone or liguleless leaf. White sheath may be loosely linked with shrunken endosperm, the cross-over percentage from a population of 626 being 46.86 ± 4.62. Kulkarni[2] has also concluded that white sheath is not closely linked with white cap.

Summary

1. White sheath, a chlorophyll abnormality of maize, is shown to depend for its expression on the presence of two complimentary unlinked recessive factors (ws_1 ws_1 ws_2 ws_2). The great variation in the intensity of this character makes it seem likely that additional modifying factors are involved in its expression.

2. Crosses between the white sheath used in this study and Kempton's white sheath prove that the latter type also carries the two factors ws_1 and ws_2.

3. Linkage studies show that white

NORMAL AND WHITE SHEATH MAIZE

Figure 5

A normal plant (left) and a typical white sheath plant (right). The leaf striping shows up very plainly in this picture and is characteristic of certain plants having an intense white sheath. The whiteness of the sheath extends from the very basal portion of the stalk to the tassel node and includes the outer husk covering the ear.

sheath is not closely linked with sun-red, white-cap, shrunken, aleurone-R, or liguleless leaf. The cross-over percentage with shrunken endosperm of 46.86 ± 4.62 suggests a loose linkage.

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BRANCHED CATKINS IN THE CRACK WILLOW

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FOR three successive years, branched staminate catkins have been observed on a number of willows (*Salix fragilis* L.) near Thiensville, Wisconsin. Most of the catkins observed have shown a dichotomous branching (Figure 6). A number of catkins have been found with two or three short lateral branches. The phenomenon has not been observed in the female inflorescence of the same species.

Approximately one-third of the catkins on each tree have exhibited the anomaly, the branched clusters being evenly distributed over the entire crown. The number of abnormal clusters on a large tree, with a trunk diameter of nearly four feet, during the spring of 1931 was more than forty per cent of the total. Smaller trees in the vicinity produced catkins of which ten to thirty per cent were abnormal. The phenomenon has been observed only on trees growing within a radius of one-fourth of a mile.

Under microscopical examination the flowers of branched catkins appeared to be normal. Serial sections through the catkin axis have shown no unusual tissue development, and no evidence of insect stings as Wilms* has suggested for *S. babylonica*. Dehiscence of the anthers took place before abscission during the spring of 1930 and 1931. Observations of this nature were not previously made.

Examination of all the sheets of *S. fragilis* in the herbaria of the University of Wisconsin and of the Milwaukee Public Museum has failed to reveal a single specimen with branched catkins. Cuttings from these willows are being propagated in another state and should yield some interesting results in the future.

BRANCHED CATKINS
Figure 6

A large willow tree and several smaller ones in the vicinity had about a third of the catkins branched, as above. It seems probable that this is an inherited characteristic, as such branching appears to be rare in this species of willow.

* Penzig, O. Pflanzen-Teratologie. Band III, p. 243. 1921-1922

THE NEED OF NATURALISTS

A MEMORIAL of the life and work of David Starr Jordan appeared in *Science* for October 2, 1931, written by Dr. Barton Warren Evermann, Director of the California Academy of Sciences, who collaborated with Jordan for many years in the study of fishes.

Evermann's testimony to the value of his association with Jordan is a significant educational record, and voices a sentiment of personal appreciation and regard that finds few parallels this side of Plato:

I first met Dr. Jordan in the spring of 1877 at Butler University where he then was professor of biology. The next year I was one of a dozen students led by Professor Jordan on a walking trip of 550 miles through the South—from Somerset, Kentucky, across Kentucky, Tennesse and North Carolina, into northern Georgia. This was, in fact, a traveling school. Dr. Jordan had been through that country before and, being quite familiar with it, he gave us at least one lecture each day on the geology, natural history or political history of the region through which we were passing.

That tramp through the South with Dr. Jordan was the most important influence that ever came into my life. I came to know him intimately and from many angles, and my admiration for his scholarly attainments and for him as a man grew day by day. I then and there determined to continue as a student of his so that I might get as much from his inspiring teaching as possible. That I did, and the association and the personal friendship begun then continued without interruption and without a single jar to the end, I always as his humble and enthusiastic helper, proud of his friendship and grateful for his patience and encouragement. (*Science*, 74:327-328, October 2, 1931.)

The relation of Jordan's work as a naturalist to his activities in other fields of science is summarized by Evermann as follows:

Dr. Jordan was, first of all, a naturalist. His intimate knowledge of many species of animals and plants, gained through observation and study in the field of many individual animals and plants themselves, was marvelous. In the making of a naturalist and the study of systematic zoology and botany, he regarded books as of value but as of only secondary importance. He often said (quoting Agassiz) "When one studies Nature from books alone, he will not know her when he meets her in the woods or fields." He was amused by the discussion of evolution and the origin of species, in the papers at the time of the Scopes trial. He felt that the only way in which species can be studied understandingly is through a careful examination and comparison of numerous specimens of different and related species. Reading books about animals and plants can not alone give any clear conception of what a species is. And one can not very clearly understand what is meant by the organic evolution of species unless he compares many specimens of closely related species. Books about animals can not lead; a study of the animals themselves must come first. Dr. Jordan was a real naturalist. He knew the animals and plants of the old farm on which he was brought up, and those of every region in which he later lived; not only the fishes (his first and abiding interest), but the birds, mammals, reptiles, amphibians, mollusks, crustaceans, lichens and the algae not only of the fresh waters and damp places but of the sea as well.

As an educator Dr. Jordan was no less great. His influence upon educational theory and practice has been profound. Even while yet at Butler College he had begun to advocate the giving of greater freedom to the student in the selection of the subjects that should be required for graduation. When he went to Indiana University in 1879 he continued to speak for greater elasticity in the curriculum. When he became president of Indiana University in 1885, he at once began to put the elective system into effect. He believed that the natural and physical sciences and modern languages are no less valuable than mathematics and the dead languages for mind development and training, and that their cultural value should be recognized. Under this system the student's major professor becomes his counselor and guide. With the opening of Stanford University in 1891 with Dr. Jordan as its first president, the really great opportunity came and Dr. Jordan embraced it with all his wonderful power and enthusiasm. With a faculty of his own selection of able young men with unbounded enthusiasm and an institution unhampered by tradition, the time was auspicious for a great adventure in higher education. It was made; and what was largely educational heresy then is now accepted throughout America. Under Dr. Jordan's influence the natural sciences be-

came respectable parts of the college curriculum.

In his study of fishes Dr. Jordan was interested in finding out what different kinds or species are found in different waters, and the relationship between those of one stream to those of other streams. To interpret the problems of geographic distribution it is necessary to know the species involved; hence careful comparison, study of differences and resemblances, is necessary; in short, to understand the origin of species it is necessary to know what the species are. Dr. Jordan did not limit his study of species of fishes to an examination of research collections; he was one of the keenest, most observing of field naturalists; he "knew fishes when he met them in their native waters" and was interested in their ecological relations.

A complete bibliography of Dr. Jordan's papers and books on fishes is not at hand, but it contains more than 450 titles. These contributions varied in size from a few pages to one of 3,528 pages and 392 plates.

Dr. Jordan once said: "I have lived three more or less independent lives: first, and for the love of it, that of naturalist and explorer; second, also for the love of it, that of teacher, and third, from a sense of duty, that of minor prophet of Democracy." And he adds that "if he had his days to live over, he would again choose all of the three." And each of these lives, filled with life's enthusiasm and faith in the final triumph of truth and righteousness in the world, he lived joyously.

For David Starr Jordan was a man who enjoyed life and who gloried in the opportunities that came to him to use his tremendous mental and physical strength for the good of his fellow man. His power of memory was astounding, his knowledge profound. He was an inspiring teacher, kind, sympathetic, utterly unselfish, and always ready to give encouragement to any student who seemed to need it. (*Ibid* Pp. 328-329.)

The service that Agassiz and Jordan were able to perform, of placing the natural sciences in the curriculum of higher education in the United States, is hardly to be over-estimated, but the advance is not being sustained. Although the larger institutions have continued to expand their biological faculties, general education in biology is not keeping pace. Fewer courses and smaller classes in botany and zoology are reported in secondary schools than a generation ago. Even agricultural colleges may offer little botany or zoology, these outdoor sciences being replaced by classroom or laboratory work in agronomy, physiology, pathology, entomology, genetics, economics, or "business administration," assuming that crop-knowledge can be taught without the study of plants. The knowledge of nature that is needed as a background of scientific farming and of constructive interest in rural life is not conveyed through the present system of education.

Huxley is quoted as defining education as "the instruction of the intellect in the laws of nature," but instruction is the wrong place for the emphasis in biological education: Darwin was a naturalist,—Huxley a professor. Intellect is only one element of personality, and "laws of nature" are only abstractions to those not familiar with animals and plants. Pedagogy is powerless to furnish the foundation of biological intelligence. Systems of formulated training may only interfere with knowledge being obtained. Interest, diligence and clear thinking are contagious habits of mind, but are not deliberate accomplishments, hardly to be taught or learned in the class-room.

It has to be recognized that the subject-matter and discipline of the biological sciences are poorly adapted to purposes of scholastic instruction. Latin and Greek were better subjects for the schools to teach, and were more useful to the potential investigator than much of the routine instruction in biological specialties. Natural history as a diversion from classical education often went farther than the present "scientific courses." A dozen students might have such an opportunity as Evermann appreciated, but not a thousand students, or a hundred, or hardly a score. The methods of mass-production have turned us away from the outdoor world. The naturalist is difficult to institutionalize, and his outlook on life is in danger of being closed.

Interest in animals and plants is a natural instinct, not acquired in school, but commonly weakened under school conditions. As children we all are

naturalists, but soon our minds are dimmed to "the light of common day." The factory has dragged the school in its wake, and the urbanized school system is rapidly reducing the race to the mental habits of mill-workers, indifferent to nature and immune to books. Our closely graded schools, that limit the contacts of the pupils to others of the same mental age, were a special invention of the devil of ignorance, disguised as a saving of labor.

The years of youth are passively sacrificed to the scholastic routine, with no experience to develop the abilities, tastes, or ideals of the out-door investigator or explorer. Formal instruction can contribute very little to the development of the scientific mind, while personal contacts with working investigators may contribute enormously. Plato tells us of Greek youths who made active search for the best teachers, but such intelligence is rare among us. Great loyalty to institutions is the conventional virtue of our system of higher learning.

Evolution in the Classroom

Many specialists in biological sciences, as pathologists, physiologists, agronomists and geneticists are very far from being naturalists, but rather are physicists, chemists or statisticians, interested primarily in the technique of their specialties rather than in the general biological problems. The laboratory mind often gives no reflection of the background of nature, and hence is unable to form a practical conception of the evolutionary process. The diversity and multiplicity of species are dismissed as a needless complexity, or arouse a peevish disparagement of the efforts that naturalists have made to explore the organic world. Systems of classification are tabooed as "taxonomy," as though geographers were to discard maps, or historians disregard dates.

Laboratory investigations of organic chemistry, physiology and pathology are carried to marvelous refinements, and reach brilliant applications in the fields of surgery, therapeutics and dietetics, but the wider applications of heredity to public health, eugenics and sociology will require a vast extension of popular interest and knowledge on the biological side, instead of a restriction or recession.

Retrograde tendencies in biological interest are shown in the use of evolution as anti-religious propaganda, and in the recrudescence of the anti-evolution controversy. Only superficial and misleading ideas are conveyed in many of the current arguments, whether for or against evolution. When the actual state of knowledge is considered, the notion of teaching evolution as a classroom exercise in high schools and colleges is seen to be essentially absurd, as Jordan recognized. Instead of the students being led to believe that they understand evolution, they should learn the need of special study in that field.

Popular knowledge of evolution needs to go much farther than taking sides in the religious debate. What nature can tell us about our racial requirements we should wish to know, even as simple prudence. Only by using our naturalist instincts do we have a prospect of gaining the knowledge and understanding that is needed for constructive solutions of our racial problems. Philosophical elaborations of abstract ideas of evolution have filled many books, but have not made plain, even to the literary public, either the facts themselves or the need of clear understanding.

The day of true democracy may come, and of better social systems, when popular knowledge extends to the natural sciences. Naturalists can see many factors of human welfare that are hidden from popular report. A notion is current that eugenics would set up a new order of aristocracy, but making capable people into parasites, instead of preserving the better families, insures their more rapid extinction. The rapidly declining birth-rates of our "cultured class" are sufficient proof that our social ideals are perverted. All of the systems of social parasitism have

the same biological effect of adverse selection. The normal instincts of development are to be obeyed and all of our abilities exercised by practical use instead of being aborted by depending on others. Parasitism is one of the primitive delusions which more knowledge of biology would help us to escape.

Democracy of Species

Biology is essentially democratic because life is organized in species, which are large groups of individual organisms related to each other through a continuous network of descent. Separate lines of descent can be analyzed in the study of particular characters, but the species as a working system is a large community of inter-breeding individuals, a form of organization suited to the evolutionary function of collecting, combining and integrating the heritable variations that appear in any of the lines of descent. Thus the species is at the same time the product and the process of evolution, as conducted through the network of descent. "Nothing living lives alone; always life is many."

If it is necessary to be a "real naturalist" in order to know species and gain an understanding of evolution and heredity, an educational system that excludes such knowledge must be reckoned as a dangerous handicap in the advancement of the race. Evolution lets us see how the processes of creation are still going on, and makes us aware that we are participants. Heredity and evolution are profoundly transforming ideas, once they have entrance to the mind. The sense of responsibilty is increased, and the obligation to understand the course of nature. How species maintain their existence and how their characters are changed, become practical questions. The biological concepts of evolution, heredity, adaptation, selection and eugenics need to be used as the basis of constructive thinking on many present day problems, to meet the call for a "wide-spread social and economic intelligence." Economics and sociology must come into practical relations with the biological sciences before they can deal constructively with problems of racial welfare, and reclaim our human birth-right in the outdoor world. The naturalists' interest in nature is an essential factor in the solution of these problems.

Many efforts have been made to graft the natural sciences on the school system, through Agassiz societies, nature study, school gardens, and house plants in school rooms, but without lasting effects. Feelings of profound disappointment with the results of scientific education are finding expression, as in the following statement which is credited to Dr. Nicholas Murray Butler, President of the Columbia University:

> The extensive and intensive study of natural science, now carried on for more than a full generation, has made no impression whatever on the popular mind. That mind continues to come to its conclusions and to formulate its choices with serene unconcern as to whether any such thing as scientific method exists.

To expect that instruction in the natural sciences would change the habits of thought among urban populations, seems hardly reasonable, but the slight influence of the natural sciences on rural life is more significant of the educational deficiency.

Biology the Key

The war and the depression make it plain that vast problems of readjustment must be solved in our over-developed industrial civilization, if our race is to survive. Biology contains the constructive elements of science which as yet have not been drawn upon, but which cannot safely be longer neglected. Physics and chemistry have entirely outrun the biological applications, creating new conditions of human existence, with new economic and social tensions, so that new adjustments must be made under peril of rapid decline of our racial stock through adverse selection. A vast structure of urban superfluity and parasitism has grown in a few decades, much too large for the over-exploited

remnant of normal people to support. The useful arts of manufacturing, transportation and merchandising have been carried to excess, with the familiar consequences of dissipation, vice and crime, poverty, disease and insanity.

No prospect can be seen that any extension of the urban scholastic system can overtake and correct the destructive misuse of science that already has taken place. The future of the race is not in the city, but in the country. Unless the racial values of country life can be appreciated, maintained and developed, there is no outlook. The urban educationists are astray with the urban industrialists, in their indifference to agriculture.

It is not an achievement to reduce the proportions of capable families engaged in agriculture, but a dangerous delusion. The race is being impoverished more rapidly by extending the urban school system into the country. Adverse selection is a powerful agency of destruction which the urban leadership of our age does not recognize, and which is sailing us close to the rocks.

The over-developed school system is a danger to be escaped, like other urban insanities. Education we need exceedingly, but too much formal instruction becomes a limiting factor in the development of the mind, as a few educational writers are beginning to see. More education and less school, may be a watchword of the future. A biological study of the development of our mental habits would bring out new factors, beyond the range of conventional pedagogy. Formal instruction may need to be restricted to six months in a year, to permit a better carry-over of the practical experience of the race through successive generations. If the schools go bankrupt the parents may reclaim their children and face the educational problems more directly.

Other agencies are required in order to develop, appreciate and apply the natural sciences, for the improvement of agriculture and the well-being of the race. Museums, zoological parks and botanic gardens are centers of "natural history," but mostly are placed in large cities. Various outdoor interests as garden clubs, forestry associations, national parks and playgrounds, bird-refuges and wild-life conservation, are receiving more attention in recent years. The American Genetic Association is a pioneer effort in the field of biological education, projected by a few farsighted men of the preceding generation who sensed the racial need of a wider understanding of the facts of heredity. The difficulties of establishing and maintaining such an undertaking show even more clearly how great is the need.

If the results of biological research are to serve the public a wider understanding is necessary, in the light of a broader culture than our present system affords. That most of our intelligent and supposedly educated people should remain completely ignorant of biology, is a dangerous situation. It may be alleged that only a few men like Darwin and Jordan have had the necessary mental equipment for entering the biological fields of thought, but this assumption should not excuse the educational system for diverting either talent or interest from the study of the central problems of our racial existence. "By the side of heredity, nothing else is important."

O. F. Cook.

In Defense of Eugenics

WEEDS IN THE GARDEN OF MARRIAGE, *by* George Pitt-Rivers. With an Introduction by Sir Arthur Keith. Pp. 83. Douglas, London. 1931.

IN this little book Capt. Pitt-Rivers endeavors to enlighten his countrymen, who very much need enlightenment, concerning the dysgenic situation which prevails in Great Britain and, in fact, in most civilized countries of the world. He takes occasion to explain what eugenics is not, as well as what it is, and this

leads him to expose some of the fallacies and absurd misrepresentations of G. K. Chesterton and G. Bernard Shaw. Here his task is easy. Then he proceeds to defend the practice of sterilization against the criticisms which have been made upon it on religious and moral grounds. The defenders of the faith in the Catholic church come in for some trenchant criticism on account of their attitude toward racial problems. The absurdity of Mr. Chesterton's railing against the violation of sacred human rights by preventing the propagation of imbeciles, while at the same time he defends the position of his Church in forbidding the marriages of cousins and even less close relatives, is presented in a telling way. The author brings out the peculiar touchiness on race problems manifested by the Jews. Anthropology, for some reason, has come to be largely a Jewish science, and most of its voteries have a very obvious bias toward egalitarianism. Capt. Pitt-Rivers, who is himself a professional anthropologist, is one of the few who have commented upon this rather interesting anthropological situation.

As a defense of eugenics against its varied kinds of critics Capt. Pitt-Rivers' book may be especially commended, since he perceives more clearly than most apologists the peculiar emotional complexes which afford the real basis for most of the opposition. The author cannot be classed as a polished controversialist, but he deals his adversaries some very vigorous and telling whacks. One of the most interesting features of the volume is the description of the eugenic practices of primitive peoples, especially the Polynesians.

S. J. Holmes.
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A Hundred and a Quarter Million of Us.

STATISTICAL ABSTRACT OF THE UNITED STATES, Pp. 898. Price, $1.25. Department of Commerce, Bureau of the Census, U. S. Government Printing Office, Washington, D. C. 1931.

IF George Washington could return on this, the two hundredth anniversary of his birth, this recent publication of the Department of Commerce could give him the dry statistical skeleton of the amazing development that is said to have been initiated by his fathering of this "Land of the Free."

In 1732 the white man's hold on the eastern edge of what was to be the United States was just ceasing to be precarious. In 1930, twenty-six and a half million automobiles killed on our three million miles of hard surfaced highways, and on our streets and byways, thirty thousand people—more than the total population of North Carolina in 1732. All of our other national statistics today, even statistics of depression, are on the same expansive scale.

Having arrived at the year 1930, just who are we people of the United States?

We are 62,137,080 males; 60,637,966 females. Our sex ratio is thus 102.5; in 1920 it was 104; in 1910 it was 106. The men seem to be "weakening" under the strain of modern existence more rapidly than the women.

Eleven million and a half of us were under five years of age and twenty-eight million of us were over forty-five. 108,864,207 of us were white; 11,891,143 of us were negro. There were 2,019,696 of other races. Sixty-four per cent of us were of native parentage, sixteen per cent were of foreign parentage, twelve and three-tenths per cent were foreign born. Of the population over fifteen years of age, (43,881,021 ♂ ; 42,837,149 ♀) about 15,000,000 males and 11,000,000 females were single. 26,327,109 men were married, and 26,170,756 women (proving that Brigham Young seems to have a large following among the ladies!) There were 2,025,036 widowers and

4,734,207 widows; about a half million of each sex were divorced; though more women than men had been legally separated from their mates.

About 5,000,000 of us could not read; (the number who knew *what* to read is not given); 69,000,000 of us lived in the city and 54,000,000 of us lived in the country. (Ten years earlier 54,000,000 of us lived in the city and 51,000,000 of us lived in the country); 49,000,000 of us were gainfully employed, 11,000,000 of us so employed being women. (This does not include housewives, who from the census point of view, spend their time with folded hands.)

Fifty-four and a half million of us belonged to a religious organization; 57,084 of us were deaf-mutes; 63,489 of us were blind; 272,527 of us were in mental hospitals; 63,642 of us were in state institutions for feeble-minded; 116,626 of us were prisoners or being "reformed"; a millon of us were born; 2,674 of us were murdered; 4,996 of us committed suicide; 1,232,889×2 of us got married; 380,969 of us entered the country as immigrants, and 290,985 left the country for other parts.

Over twenty million of us were going to school at a total cost for the rest of us of two and a tenth billion dollars. The value of college grounds, buildings, and dormitories was a billion and a half dollars. It cost us a lot to be governed in 1930: about $70 per capita for state governments and $33 per capita for the National Government. (If England had tried to levy such a tax in 1730 the revolution might not have waited for George Washington to grow up!)

We did a lot of banking and a lot of railroading, and a good deal of foreign commerce, and a great deal more domestic commerce, and a lot of other things. We manufactured many things (too many!), and raised many things, and we seem to have had too large a cotton crop and very much too much of a wheat crop.

Anyone with a stub pencil and a gift for figures can find an enormous amount of interesting material in this dry volume. Perhaps if the pencil holds out he can find out what happened to those 200,000 missing wives and why there are two million and a half more widows than widowers. Marriage *does* seem to be rather a problem for the male!

R. C.

Statistical Mountains—Correlational Molehills

CHILDREN'S BEHAVIOR PROBLEMS, A Statistical Study Based upon 5,000 Children Examined Consecutively at the Illinois Institute for Juvenile Research, *by* LUTON ACKERSON, Research Psychologist, Institute of Juvenile Research and Behavior Research Fund, Chicago. Pp. 268. Fifteen Chapters. 57 Figures. Price, $4.00. University of Chicago Press, Chicago. 1931.

ANYONE who has been, as a child, a close and mystified observer of his own conduct, who has regretfully noted the behavior of his offspring, or has been the scandalized witness of the acts of their associates, will appreciate the magnitude of Mr. Ackerson's problem. It is not made any easier by the fact that the data are not his own observations but were gathered by different members of the staff of the Institute for Juvenile Research. Readers are assured, somewhat impressively, by a director, that the individual studies of children—upon which the statistics are based—"represent in every instance the combined analysis of the psychiatrist, psychologist, physician, and psychiatric social worker." A justly retributive alliteration, for the children had not been minding their P's and IQ's.

One gathers that the institutional staff is rather proud of the richness of the compilation of juvenile iniquity which it has assembled, for the round total of 5,000 cases is frequently mentioned. This may be what prompts the author to spread his material out in page after page of tables of notations. One is actually able to apply an old

statistical stand-by, for if the items against two of the most heinous individual cases are laid side by side—and they are—they extend six pages!

One doubts immediately the efficacy of the correlation coefficient as a tool to clean up so heterogeneous an Augean litter, particularly when the information gets to the statistician second or third hand and deals with misdemeanors about which children and their parents habitually lie.

The author comments conscientiously upon the subjectivity of the data and rather näively admits his relief at getting any correlations at all. He comforts himself with the belief that inaccuracies would reduce but not produce correlations.

The opus major of the monograph is a tremendous series of curves and correlations. The material was divided into "personality" and "conduct" problems, the notations of the former group depending upon the definitive skill of staff members. Then for each sex the individual problems, with frequencies over 30, were correlated with chronological age and, subdivided into two age groups, with intelligence quotient. Special subdivisions of the material were tested in many instances.

The presentation of the data is a model of statistical arrangement; results show at a glance. And thus it takes little more than a glance to see the meagreness of the issue of this montanic statistical travail. Most of the coefficients are of negligible size, while some of the most pronounced ones are of negligible informational value. Bed-wetting is shown to be negatively correlated with chronological age, but this fact was long since established by mothers who used merely rule of thumb, or perhaps rule of palm methods. A negative correlation between age and illegitimate pregnancy would have been "news," but naturally a positive one was obtained.

Intelligent children as a group proved to have some more desirable and many more *un*desirable traits than stupid ones, the correlation between I. Q. and bad behaviour being particularly pronounced in children below 13 years. Whether, after this age, they are better behaved, or more careful, or given up as a bad job and not taken to a juvenile clinic, it is hard to say. The author recognizes selection in the cases as a "formidable limitation," although he finds no evidence of a pronounced distorting effect from selective factors. Judging by what they did, they were a fairly average group of children, and an honest reader, after a reminiscent blush, would be inclined to say about even the worst of them: "There but for the grace of God go I."

It seems to the reviewer that a fair conclusion to come to with regard to this monograph is that the author has done a well planned and painstaking piece of work upon very unfavorable material and that the results obtained are not particularly impressive. More valuable information will be obtained when the combined analysis of the psychiatrist, psychologist, physician and psychiatric social worker is as ineluctable as it sounds.

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Origin of the Slavs

L'ESPANSIONE DEGLI SLAVI, by Haskel Sonnebad. Comitato Italiano per lo Studio dei Problemi della Popolazione, Serie I, Vol. I. Pp. 238. Rome, 1930.

Placing the origin of the Slavs in the region north of the Carpathians, the author holds that they resulted from a fusion of three elements—a pre-Slav group, a Baltic race, and the Nordics. Since this origin, it appears that there has been a progressive tendency toward round-headedness. The diffusion of the group eastward, southward, and westward, is traced in detail with a wealth of reference.

Paul Popenoe.

PARTLY FERTILE HYBRIDS OF COMMON WHEAT WITH KHAPLI EMMER*

LILLIAN HOLLINGSHEAD†
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ORDINARILY common wheats which have 42 chromosomes, may be crossed readily with wheats of the Emmer group, which have 28 chromosomes. The hybrids are vigorous and fairly fertile and several investigators have succeeded in combining a desirable character from a wheat with the lower chromosome number with desirable characters of a common wheat to produce a variety of common wheat of considerable promise agronomically.

Khapli Emmer (*Triticum dicoccum*) is an early maturing variety which possesses very high resistance to most physiologic forms of wheat stem rust. Attempts to transfer this resistance to common wheats however have proved almost completely unsuccessful because of the death of most F_1 hybrids before maturity. Puttick[6] reported that crosses between the common wheat variety Marquis (*T. vulgare*) and Khapli set no seed. Hayes and Stakman[2] report disappointing results from attempts to cross Khapli with Marquis wheat. Hynes[3] however secured four F_1 plants from crosses of Federation (*T. vulgare*) with Khapli which were quite normal and produced heads bearing plump grain. Thompson and Hollingshead[9] reported that of 80 hybrid grains obtained from crossing Khapli with *T. vulgare* many failed to germinate and all but two of the seedlings died before reaching a height of eight inches. Only those two ever formed heads.

Waterhouse[10] made a long series of attempts to secure hybrids between different varieties of *T. vulgare* and Khapli Emmer. He used Federation, the variety used by Hynes, as the *vulgare* parent in over half the crosses but from 162 grains set he did not obtain a single mature plant. Including all varieties 1,860 pollinations were made, 284 hybrid seeds were obtained and only two of these produced tiny ears with two spikelets on each side. In one spikelet on one ear three small stamens were produced, and in one spikelet of the other ear a small pistil was formed. No seed was obtained. The other plants were stunted, but it was noted that there was a difference in degree of development attained by the hybrids, according to the *vulgare* parent used, the plants dying at heights averaging from 6 to 12 inches depending on the *vulgare* parent.

The Hybrids

It occurred to the writer that it might be possible to produce more vigorous hybrids between Khapli Emmer and a variety of common wheat if the latter were itself a derivative of a cross between a common and an Emmer wheat. For this purpose H-44-24, a variety produced by McFadden[5] from a cross between Marquis and Yaroslav Emmer, was chosen. Preliminary attempts to obtain this cross in 1929 resulted in several seeds from which three supposed hybrids were obtained but they died in a period of dry weather before maturing.

In 1930 Mr. Julian Hessel pollinated H-44-24 and Hard Federation with Khapli pollen for the writer. Table 1 gives the results obtained. The percentage of successful pollinations when H-44-24 was the *vulgare* parent were

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† Cereal specialist.

PARENT AND HYBRID FORMS

Figure 7

At the left is one plant of the female parent variety, H-44-34. The other two plants are hybrids of this form with Khapli Emmer. The Emmer wheats (*Tricitum dicoccum*) have twenty-eight chromosomes; ordinary wheat (*T. vulgare*) has 42 chromosomes. Khapli Emmer, an early maturing strain with high resistance to rust, does not produce fertile hybrids with most of the varieties of ordinary wheat. The variety H-44-34 is a form which has been originated from a hybrid of common wheat and another variety of Emmer. The presence of this Emmer "blood" (or, more accurately, of Emmer *chromosomes*) facilitates the obtaining of fertile hybrids.

as high as in several crosses made by Mr. Hessel in the same season between varieties of wheat with the same chromosome number. The difficulty in obtaining hybrid seed when Hard Federation was the *vulgare* parent is in agreement with Waterhouse's results, for this was one of the varieties he used.

Most of the hybrid seeds (46) were sown in pots in the greenhouse and practically all of them germinated and grew into normal vigorous seedlings. Infected with stem rust, *Puccinia graminis tritici* form 21, some of the hy-

HEADS OF PARENT VARIETIES AND OF HYBRIDS

Figure 8

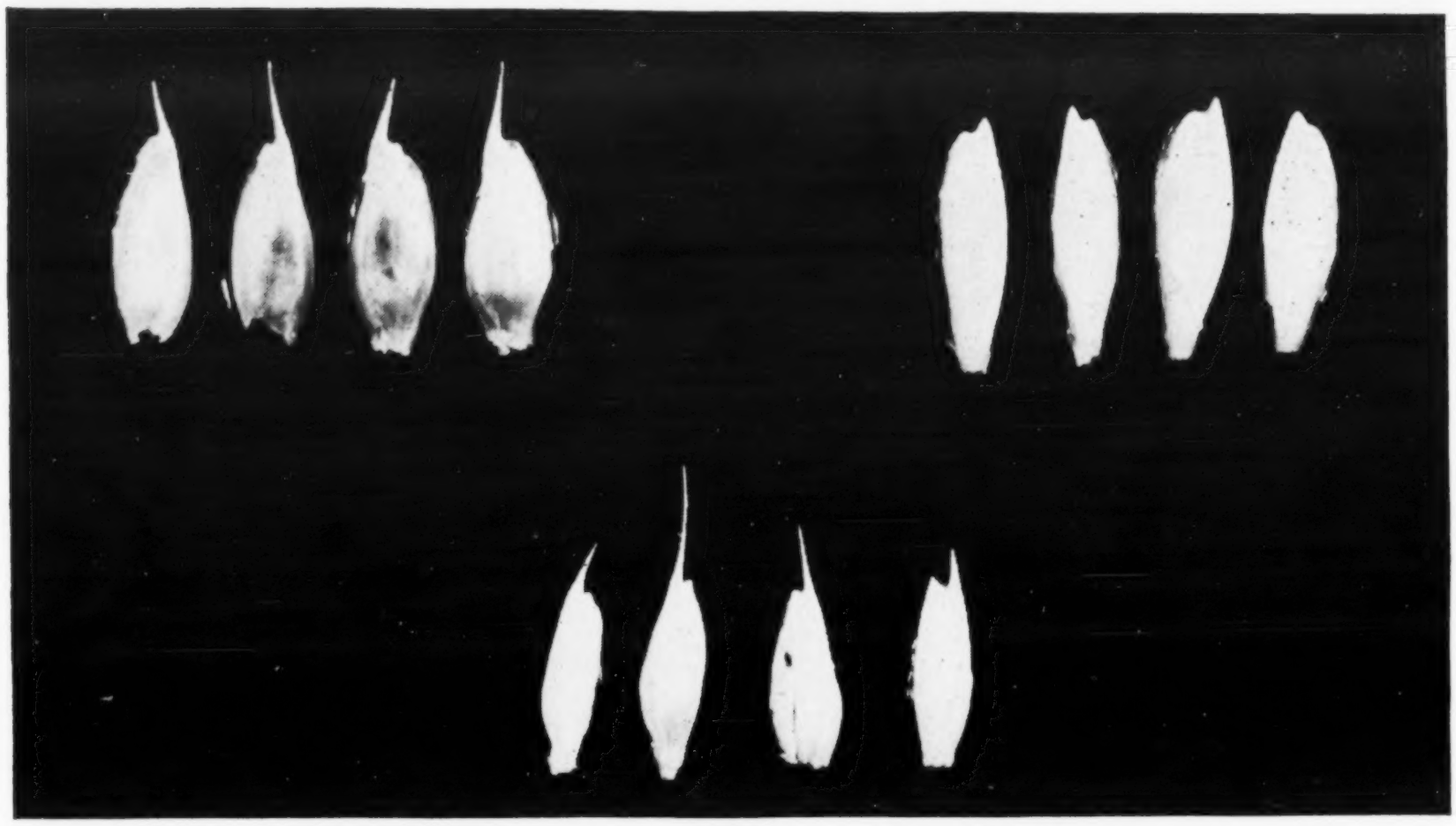
At left, two heads of variety H-44-24; right, two heads of Khapli Emmer; and, center, two heads of the F_1 hybrid between these forms. Fertile seed has been obtained in the green house, but under more rigorous conditions the hybrid scarcely reaches maturity.

brid seedlings gave a reaction of 1 +. Khapli under the same conditions gave a 1— while H-44-24 gave a 3=c to 3c+ reaction. The hybrids were therefore not quite as resistent to this form of rust as the Khapli parent, but much more resistant than the H-44-24 parent. The inoculation with the rust and the readings were kindly done by Dr. T. Johnson.

As the plants approached the heading stage some of the leaves began to turn yellow and this yellowing increased as the plants matured. Figure 7 is a picture of one pot of H-44-24 and of two pots of the hybrids, each with three plants. The hybrids were not as far advanced as the H-44-24 plants when this picture was taken. The mature hybrids usually had several well developed heads per plant and a number of stunted tillers. Figure 8 is a picture of typical heads of the hybrids and of the parental varieties. The hybrids resemble the Khapli parent in shape of spikelets and heads. The outer glumes (Figure 9) of the hybrids are like those of Khapli in shape, but

TABLE 1.—Results obtained from pollinating two *vulgare* wheat varieties with Khapli Emmer pollen.

Vulgare Parent	Number of Florets Pollinated	Number of Grains set
H-44-24	125	58
Hard Federation	149	0



GLUMES OF PARENTS AND HYBRIDS

Figure 9

Above, at left, are the glumes of H-44-24 and (right) of Khapli Emmer. Below are the glumes of the F_1 hybrid. The glumes resemble the Khapli parent in shape, but they resemble the other parent in smoothness and in length of apical tooth.

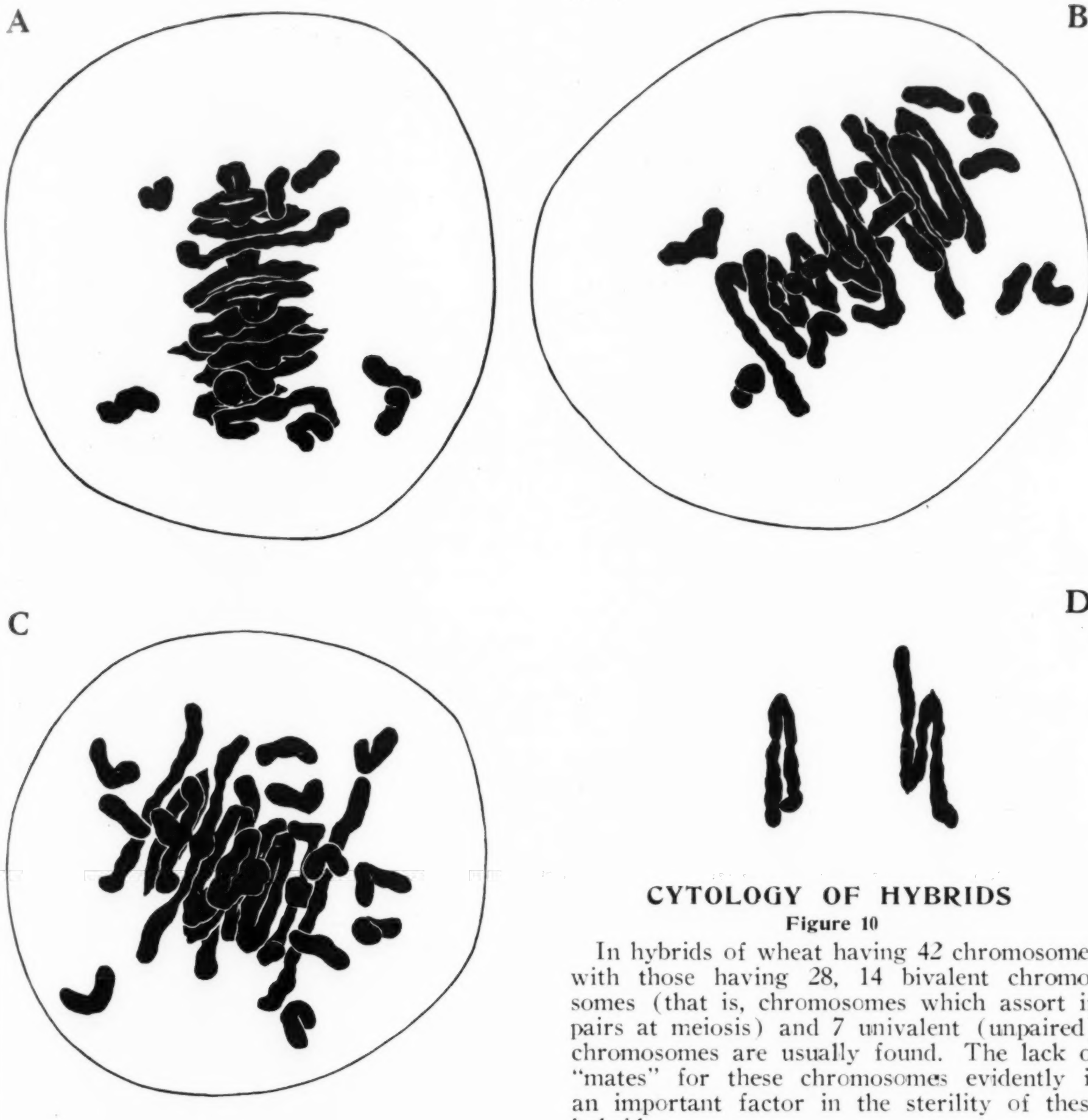
they resemble the H-44-24 parent in smoothness. In the length of the apical tooth, which is quite variable, they are more like the H-44-24 parent.

There were sometimes none, but usually one to several grains per head; sterility is therefore considerably higher than in other previously described hybrids between wheats with 42 and 28 chromosomes (pentaploid hybrids). These grains germinated well and the F_2 plants varied widely in appearance as is characteristic of this generation of pentaploid wheat hybrids.

The reserve of the hybrid grains (to grow into F_1) was planted outside early in May, 1931. They germinated well and the plants grew normally until a period of dry weather occurred in early June when the leaves began to turn yellow. In spite of artificial watering and later adequate rain, the plants produced none or few tillers, headed when very short, and on the whole were considerably poorer and weaker plants than their greenhouse sisters had been. It would seem that these hybrids are unfitted to withstand unfavorable weather conditions.

Cytological Studies

Meiotic divisions of the pollen mother cells of the F_1 were examined from paraffin sections of anthers fixed in chrom-acetic formalin preceded by a short time in Carnoy, and from anthers fixed in Carnoy, washed in alcohol and crushed in acetocarmine, as described by Thompson[8]. Most of the cytological work was done on greenhouse material. As in other pentaploid hybrids 14 bivalent and 7 univalent chromosomes were usually to be found at the first meiotic metaphase. Figure 10*A* is a side view of such a cell but some of the bivalents are hidden. However more than 7 univalents (Figures 10*B* and 10*C*), and a corresponding decrease in the number of bivalents could also be found. In cells which showed more than 7 univalents the common number was 9, and the highest, which was seen rarely, was 13. The proportion of cells showing more than 7 univalents varied markedly in different samples of material but in typical anthers it was estimated to be about 20 per cent. This estimate is based on the examination of 136 cells



CYTOLOGY OF HYBRIDS

Figure 10

In hybrids of wheat having 42 chromosomes with those having 28, 14 bivalent chromosomes (that is, chromosomes which assort in pairs at meiosis) and 7 univalent (unpaired) chromosomes are usually found. The lack of "mates" for these chromosomes evidently is an important factor in the sterility of these hybrids.

At *A*, above, is shown a cell at first metaphase, with the fourteen paired chromosomes in the center, and the seven unpaired chromosomes around this group. Four of them are across the lower edge of the picture, and three across the top, one of them projecting over the central group. At *B* is shown another first metaphase, with nine univalent chromosomes in addition to the paired chromosomes in the center. Eight of these are distributed around the central group and one lies over it. At *C* is a similar figure showing eleven univalent chromosomes in first metaphase cell. At *D* are shown trivalent and tetravalent chromosomes (i. e., three and four chromosomes united together) found in the cells of these hybrid forms.

from several anthers in particularly favorable areas of slides from aceto-carmine material where slight flattening of the cells and good staining made it possible to determine the number of univalents in most of the cells with a fair degree of accuracy. An estimation based on a larger number of cells from groups in which the number per cell could not be distinguished in a greater proportion of cases was about 24 per cent. An even higher proportion of cells with more than 7 univalents, conservatively estimated at 50 per cent, was found in anthers from two late tillers.

In the pollen mother cells of most pentaploid wheat hybrids described by

various writers, 14 bivalents and 7 univalents seems to have occurred very regularly (Watkins[11]). Sax[7] however, found 3 cells with more than 7 univalents at first anaphase in a total of 36 cells in a *T. vulgare* × *T. durum* hybrid. Kihara and Nishiyama[4] report 13 bivalents and 9 univalents to occur rarely in *T. vulgare* × *T. durum* hybrids, and Aase[1] found 7 to 11 univalents in the same hybrids. It would appear that H-44-24 × Khapli hybrids show more deviations from the usual combination of bivalents and univalents than do other pentaploid hybrids reported. The writer does not know of any reported observations on other *T. vulgare* × *T. dicoccum* hybrids however, but has made preliminary studies of *T. vulgare* (var. Marquis) × *T. dicoccum* (var. Vernal) hybrids. Pollen mother cells with more than 7 univalents were to be found in all samples of the material studied and the proportion of such cells estimated from very good material was about 18 per cent. This may be high, however, for it was partly based on anthers from some short early tillers which were produced shortly after the plants had been transplanted from the greenhouse to the open. Anthers from later more vigorous tillers had a smaller proportion of such cells. More extensive work on both hybrids would have to be done before a decision could be reached whether the H-44-24 × Khapli hybrids are more irregular than the Marquis × Vernal hybrids.

As in the *T. vulgare* × *T. durum* hybrids described by Kihara and Nishiyama[2] and by Aase[1] trivalent and tetravalent chromosomes were to be seen rarely in the H-44-24 × Khapli hybrids (Figure 10*D*). No attempt was made to ascertain their frequency.

Following the first metaphase the meiotic process follows the type so often described for other pentaploid wheat hybrids. The univalent chromosomes usually divide at the first anaphase though they do not always do so, for frequently less than 7 univalents are to be found dividing at this stage. Probably those which do not divide at the first, divide at the second division. Lagging chromosomes at the second division give rise to micronuclei in many of the cells of the young tetrads.

The mature pollen contains a considerable proportion of empty or partly empty grains when examined in lactic acid and fuchsin. The proportion of such "bad" pollen in several counts varied from 34 to 51.4 per cent. Usually the proportion of such pollen in pentaploid hybrids is about 25 per cent (Watkins[11]). The higher proportion in the H-44-24 × Khapli hybrids probably accounts in some degree for their higher sterility.

The fact that these partly fertile hybrids between Khapli Emmer and a common wheat have been obtained, is of some theoretical as well as some practical interest. They differ in several characteristics from the Hard Federation × Khapli hybrids described by Hynes, being considerably less vigorous and fertile. Indeed some doubt has been cast on the real nature of Hynes' hybrids by the fact that Waterhouse was unable to secure normally maturing hybrids using the same two parental varieties. In any case it is certain that hybrids of Khapli with a number of different *vulgare* varieties usually die before maturing. Whatever the cause of this lack of vigor may be, the vigor of such hybrids may be increased, and some grains may be obtained, if the *vulgare* parent is H-44-24, a variety which has part of its genetic make up of Emmer origin. Possibly other varieties of similar origin, such as Hope, may cross with Khapli to give a still more vigorous and more fertile hybrid.

Summary

Partly fertile normally developed hybrids of a common wheat with Khapli Emmer have been obtained. The common wheat parent (H-44-24), is itself derived from a cross between a common (*T. vulgare* var. Marquis) and an

Emmer (*T. dicoccum* var. Yaroslav Emmer) wheat. The hybrids grew best in the greenhouse and appeared to be rather unfitted to withstand unfavorable weather conditions.

Cytologically they are more irregular than other pentaploid wheat hybrids previously described, having more than seven unpaired chromosomes in a portion of the pollen mother cells. It is not certain however, that they are more irregular than Marquis × Vernal hybrids which are hybrids between different varieties of the same two species.

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Physiology of the Cell

A TEXTBOOK OF EXPERIMENTAL CYTOLOGY, *by* James Gray, M.S., F.R.S., Fellow of King's College, Cambridge, and Lecturer in Experimental Zoology, University of Cambridge. Pp. 516. 18 Chapters, 3 Plates, 205 Figures, 75 Tables. Price $7.50. New York, The MacMillan Co. 1931.

THERE are a number of excellent text-books of cytology in which the cell is treated primarily as a morphological unit. In Gray's "Experimental Cytology," however, it is considered rather as a "convenient unit of functional activity."

Students of the cell have too frequently belonged to one or the other of two somewhat opposed camps, the morphological and the physiological. The morphologists, who are more apt to call themselves cytologists than are the physiologists, have shown a special inability or unwillingness to understand and utilize the methods and conclusions of the physiologists, and it is time that a greater degree of familiarity and a larger measure of cooperation between the two groups were established. Gray's "Experimental Cytology" should be of considerable assistance to morphologists as they seek to evaluate the results of physio-chemical investigations upon the nature and activity of protoplasm.

The book is especially well suited to this use, as well as to use as a text-book, inasmuch as it displays throughout a well-balanced judgment with respect to the results already accomplished by the methods of physical chemistry. While the analytical methods of chemistry and physics are utilized as far as possible in interpreting the behavior of cells, both vegetative and reproductive, excessive claims as to past or future achievements are avoided, and there is an evident unwillingness to adopt theories which are not subject to immediate experimental analysis, or for which there is inadequate foundation in fact. The author refers to the "danger of underestimating the complexity of the whole problem," and insists that the

"biologist should continue to regard the situation from his own peculiar angle," as a check, perhaps, upon over-enthusiastic claims of the physical chemist. Emphasis is placed upon the fact that all analogies between protoplasm and purely inanimate systems sooner or later break down, and that there is no real parallel between them. Thus, we read,— . . . "we can only ascribe to nuclei the properties of a highly instable and delicately poised system, whose instability is probably an essential feature of the living state and which finds no adequate parallel in inanimate systems." Or again,—"Try as we will, it seems impossible to point to any inanimate system (endowed with the known chemical or physical properties of the nucleus) which in any real way possesses the requisite complexity whereby it might reflect even feebly the biological facts." And once again—" It seems more rational to regard living material as a state of matter where the constituent molecules are organized in a way quite unknown in the inanimate world, and which will only be elucidated by methods of analysis which have yet to be discovered. The study of protoplasmic structure clearly illustrates the limitations of a purely physical conception of biological problems. Without doubt the underlying mechanism of cytoplasmic differentiation is of an atomic or electronic nature, but until we have the means to explore the situation in much greater detail, a knowledge of our ignorance is perhaps the most valuable asset we can hope to possess."

While on the one hand, therefore, the methods of physics and chemistry are adopted as far as possible in the solution of cytological problems, emphasis is laid on the other hand, upon the unique complexity of living matter and upon our "very profound ignorance" of the fundamental nature of animate systems. The constantly critical attitude in evidence throughout the book greatly enhances its value. As a summary of the newer point of view in cytology, therefore, this is a worthy contribution, and should meet a great need.

Bibliographies are found at the end of each chapter, and author and subject indexes are placed at the end of the volume. A summary of chapter headings will indicate the scope of the work: The Cell as a Unit of Life; The Cell as a Physical Unit; Cell Dynamics; The Cell as a Colloidal System; The Physical State of Protoplasm; Cell Membranes and Intercellular Matrices; The Nucleus; Mitosis; Cell Division; The Shape of Cells; The Growth of Cells; Cell Variability; The Equilibrium between a Living Cell and Water; The Permeability of the Cell Surface; The Nature of the Cell Surface; The Germ Cells; Contractile Cells; Phagocytosis.

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